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BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

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SUBJECT—

TITLE

TESTS TO DETERMINE REPELLENT AND CONTROL EFFECTIVENESS
OF CERTAIN FORMULAE OF THE
DOW CHEMICAL COMPANY
1940

by
Archie L. Gibson
Assistant Entomologist

Forest Insect Laboratory
Coeur d'Alene, Idaho
February 7, 1941

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Forest Insect Laboratory
Coeur d'Alene, Idaho
February 7, 1941

Dr. F. C. Craighead

Washington, D. C.

Dear Dr. Craighead:

I am enclosing two copies of Mr. Gibson's report "Tests to Determine Repellent and Control Effectiveness of Certain Formulae of the Dow Chemical Company, 1940". This report shows the results obtained from the Dow chemicals sent to this laboratory last season.

Mr. Gibson has taken the brood data obtained from the examination of the 6-inch strip at the end of each log to establish potential brood for each log at the time of treatment. The mean of these data was taken to depict the living brood per square foot of bark surface for each treatment as shown in table 1. An average of the living insects per square foot found in the material after treatment was then compared to the potential average to obtain the percent of reduction. Although for K-655 and 2-X the percent of reduction would appear satisfactory, the variation in the data was, as Mr. Gibson has stated, so great that no significance can be applied to these figures. For example, with the five logs treated with K-655 the percent of reduction varied from 99.6 to 76.0 percent. Furthermore, the brood potentials per square foot before treatment varied from 26 to 103. As expected, the best results were obtained in the heavily infested material, due to the dryness of the bark associated with such conditions.

In testing the effects of the Dow chemicals against the mountain pine beetle in whitebark pine Mr. Gibson included both 1939 and 1940 attacks. The same technique was employed to obtain the percent of reduction, which with K-655 appears satisfactory. However, a question can be raised as to the significance of this result, as at the time of treatment there had been some emergence. Although Mr. Gibson attempted to bring into adjustment the emergence holes that existed before and after treatment, the difficulty of properly evaluating this factor, with the variation which existed in the factual data obtained, should be recognized. If the treatment was more effective in whitebark pine than in lodgepole pine there must be more to the difference in environmental conditions than we hav anticipated.

It is trusted that Mr. Gibson's report will provide the information which you desire.

Respectfully yours,

JAMES C. EVENDEN
Senior Entomologist

Enclosures

cc to:
Mr. Miller
Mr. Keen
Mr. Furniss

TESTS TO DETERMINE REPELLENT AND CONTROL EFFECTIVENESS OF CERTAIN FORMULAE OF THE DOW CHEMICAL COMPANY 1940

INTRODUCTION

In the spring of 1940 three formulae manufactured by the Dow Chemical Company were sent by authorization of the Washington office of the Bureau of Entomology and Plant Quarantine to the Coeur d'Alene Forest Insect Laboratory to be tested for their effectiveness in repelling and controlling the mountain pine beetle. These formulae were (1) para-chloro-phenoxy-ethoxy-ethyl chloride (K-655), (2) para-tertiary-butyl-phenoxy ethanol (K-58), and (3) dichlordiphenyloxidae (2-X), which will be referred to in the rest of this report as K-655, K-58 and 2-X.

MATERIALS AND METHODS

In all tests of these formulae one part by volume of each of the above chemicals was mixed with three parts kerosene. Materials treated consisted of 30-inch log sections of lodgepole and whitebark pine supplemented by standing infested trees, all infested with the mountain pine beetle.

Log sections and trees were sprayed until the bark surface glistened with the unabsorbed oil and dripping was ready to start, thus assuring thorough saturation. In selecting material to be sprayed, all log sections without sufficient living brood in a six-inch strip on one end and all trees with too few living insects were rejected. Unsprayed sections were placed among those treated to serve as checks.

Both treated and untreated sections were set on end on low, open-floored platforms in the shade of timber and branches to prevent any possibility of sun killing but otherwise to closely duplicate natural conditions of exposure. Enough space was left between sections to prevent the chemical from influencing mortality of the brood in nearby logs.

One-half the circumference of the basal five feet of trees was sprayed and the other half left unsprayed to serve as a check on the treatment.

EXPERIMENTS

Tests Against Advanced Stages of Brood Development in Lodgepole Pine

On June 25 and 26 three lots each of five 30-inch sections of lodgepole pine at Grand Teton Park were sprayed with the three formulae. To supplement the data from the logs, three lots of five trees each were sprayed with the same formulae on July 5. Both the trees and the log sections were examined in early August, condensed data from the sections being given in table 1.

Table 1 - Spraying lodgepole pine to control the mountain pine beetle

Data from examinations of trees attacked in 1939

	Prior to spraying		After spraying		
Formula	Living brood per sq. ft.	Sq. ft. area examined	Living brood per sq. ft.	Sq. ft. area examined	Percent reduction
K-655	48.3	9.0	3.1	16.0	94
2-X	72.9	8.4	5.2	18.3	93
K-58	48.9	8.0	17.6	17.0	64
Brood in three untreated sections	17.4		10.6		

Although formulae K-655 and 2-X gave decided reductions in brood, the results cannot be considered satisfactory, because of the variability in survival between log sections as well as considerable survival. Results with K-58 were not satisfactory.

Extensive examination of the 15 trees treated with the three formulae revealed 92.5 percent reduction secured with K-655, 94 percent with 2-X, and 68 percent with K-58. These findings agree quite closely with those of the intensive examination.

Repellent and Control Effect Against Young Brood in Lodgepole Pine

To test the repellent and control effect of the formulae, three lots of five sections each of lodgepole pine in the initial stages of attack by the mountain pine beetle were treated on August 1 in the same manner as the sections sprayed in June. Three unsprayed sections were placed with each sprayed lot of five logs. To supplement the above tests one-half the circumference of the base of trees in the same initial stages of attack was treated, two each with K-655 and K-58 and three with 2-X. Trees were selected that showed initial stages of attack because presence of the latter indicated the trees were desirable host material and eliminated the problem of chance immunity if unattacked trees had been selected.

Prior to treatment, all sections and trees were carefully examined and all new attacks marked, in order that any attacks subsequent to treatment could be easily identified as such.

An extensive examination of sections and trees revealed the following condition five weeks after treatment:

Control and Repellent Effect of Dow Chemicals on
Mountain Pine and Secondary Bark Beetles
Grand Teton Park - 1940

Formula	Effect on Mountain pine beetle	Repellent effects on Mountain pine beetle	Repellent effects on Secondary bark beetle
K-655	Partial control	Partially	Good
2-X	Partial control	Partially	Fully
K-58	Partial control	Partially	Partially
Checks	Normal development	Light to heavy "fillin"	Heavy attack

From the preceding data it is seen that none of the formulae gave good control of brood of the mountain pine beetle in the egg and small-larval stages of development and none were fully repellent to the mountain pine beetle. Formula 2-X was fully repellent to secondary bark-beetles, formula K-655 was quite effective, and K-58 only partially effective.

Tests Conducted in Whitebark Pine
Mt. Washburn, Yellowstone Park - 1940

This experiment was also divided into two sections, based on brood development at the time of treatment, thus permitting a comparison of effectiveness of the spray formula on brood in both early and advanced stages of the mountain pine beetle.

Both log sections and trees were used in the experiment. The data secured are shown in condensed form in the following two tables.

Table 2 - Spraying whitebark pine to control the mountain pine beetle

Data from examinations of trees attacked in 1939*

Formula	Living brood per sq.ft.	Area examined	Living brood per sq. ft.	Area examined	Percent reduction
K-655	11.6	7.6	.0	20.8	100
2-X	10.0	7.7	.7	21.3	93
K-58	23.2	8.1	2.3	21.2	90

*Advanced stages of brood development

From the preceding experiment it is seen that complete control was obtained with formula K-655 and good results with the other two formulae on the advanced stages of development. The data from sections and trees treated to destroy brood from 1940 attacks are presented in table 3.

Table 3 - Spraying whitebark pine to control the mountain pine beetle

Data from examinations of trees attacked in 1940*

Formula	Living brood per sq. ft.	Area examined	Living brood per sq. ft.	Area examined	Percent reduction
K-655	362.9	3.5	45.3	8.6	87.5
2-X	341.4	3.5	52.2	7.8	85
K-58	376.7	3.0	75.3	7.5	80

*Egg and small-larval stages

Although from the data the reduction noted is considerable, it must be pointed out that too many insects are present seven weeks after treatment to justify general use of the formulae. That further reductions may take place with longer exposure to the spray is possible, but the

development of the brood in the sprayed areas was progressing sufficiently to indicate that many insects might mature.

CONCLUSIONS

The general conclusions that can be drawn regarding the effect of these formulae in lodgepole and whitebark pine are:

(1) That good control can be secured with two of the three formulae if brood is in the advanced stages of development. Formula K-655 is apparently the most effective of the three, with 2-X only slightly less so, and K-58 the least lethal.

(2) None of the formulae are sufficiently lethal to brood in the early stages of development, due quite likely to the greenness of the bark, which greatly retards absorption of the spray when in that condition.

(3) None of the formulae are fully repellent to mountain pine beetle attack in lodgepole pine, although all were partially effective. Formula 2-X proved fully repellent to secondary bark beetles, K-655 highly repellent, and K-58 partially effective.

SUMMARY

Three formulae manufactured by the Dow Chemical Company and tested against the mountain pine beetle in lodgepole and whitebark pine revealed K-655 to be the most effective of the three in controlling mountain pine beetle brood, with 2-X slightly less effective, and K-58 considerably less so. While control was excellent with K-655 and good

with 2-X and K-58 against advanced stages of brood development in white-bark pine, these formulae were considerably less lethal to the same brood stages in lodgepole pine. Other formulae now being used are more uniformly effective and have the decided advantage of being much cheaper.

Early stages of development of the mountain pine beetle were quite resistant to control by these formulae in both timber species and the results cannot be considered satisfactory.

As repellents against secondary bark beetles, formula 2-X proved fully effective, K-655 only slightly less so, and K-58 still less repellent.